



## Environmental Microbiology: EESC30H3 S

**Instructor**

Dr. Patricia Dörr de Quadros

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Office hours: Online, pre-scheduled.

**Lectures:** Fridays 1-3 pm

Online Synchronous  
(Quercus/ BB Collaborate)

**Pre-requisites:** CHMA10H3, CHMA11H3,  
BGYB50H3, BGYB51H3

TA: Patricia Miller

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### Course Description

Environmental Microbiology introduces students to the fascinating world of microorganisms highlighting their evolution, importance, and functionality in the most varied environments. Students will learn about microbial abundance and diversity, and how microbes can function differently in common habitats such as soil and water, and in peculiar niches under extreme environmental conditions. We will explore the importance of microorganisms in soil formation and quality, nutrient cycling, biomass biodegradation, plant health and growth, and how to use them to improve agriculture and bioremediate contaminated soils.

In this course students will also learn how microorganisms can communicate with each other using signaling molecules, and how their genetic potential can be used for the advance of biotechnological processes. Furthermore, students will learn how to perform scientific experiments for monitoring, quantification, and qualification of microorganisms associated with plants, soil, and water, and how to use DNA sequences for identifying species and their function.

This course will provide students with the ability to demonstrate their knowledge of prokaryotic biodiversity and function, and to apply this understanding to solve problems and find solutions related to current environmental issues that threaten planetary and human health (i.e.: antibiotic-resistance, pollution, and global warming).

### Student Learning Objectives

**By the end of the course, students will be able to:**

- Recognize the importance of microbial communities to the functioning of diverse ecosystems;
- Compare and evaluate microbial communities based on their DNA sequences;
- Predict changes in microbial community structure according changes in biotic and abiotic factors;
- Understand how plants, soil, and human microbiomes are interconnected and how they can influence each other;
- Integrate their knowledge in environmental microbiology and ecosystems management to find out solutions for environmental issues.

# Schedule:

Module / Week	Date	Lecture Topics	Readings
1	January 15 <sup>th</sup>	<b>Introduction, expectations, syllabus and course structure</b>  <b>Microorganisms in the Environment</b> <ul style="list-style-type: none"> <li>- Microbial evolution and diversity;</li> <li>- A historical perspective;</li> <li>- Overview of functions and applications of microorganisms.</li> <li>- Interconnectivity of ecosystems.</li> </ul>	Knoll, 2015 Hug et al., 2016
2	January 22 <sup>nd</sup>	<b>Finding Energy and Carbon; Adaptations to Extremes</b> <ul style="list-style-type: none"> <li>- Microbial metabolism and activity;</li> <li>- Range of conditions that support life and how microorganisms are adapted to it (i.e. temperature, salt, pH etc);</li> <li>- Overview of the diversity of electron donors, acceptors and carbon sources within the three domains.</li> </ul>	Smith et al., 2019 Vigneron et al., 2019
3	January 29 <sup>th</sup>	<b>Biogeochemical Cycling; Aquatic microbiology</b> <ul style="list-style-type: none"> <li>- Influence of microbes on carbon, nitrogen, and sulphur cycles;</li> <li>- Influence of microorganisms on soil formation and quality;</li> <li>- Microorganisms in aquatic environments.</li> </ul>	Falkowski, 2008
4	February 5 <sup>th</sup>	<b>Using DNA sequencing for identification of microbial taxonomy and function</b> <ul style="list-style-type: none"> <li>- Microbial diversity;</li> <li>- DNA, genome, and metagenome;</li> <li>- DNA sequencing: methods and examples of data/current findings;</li> <li>- OMICS;</li> <li>- Metabolic pathways.</li> </ul>	Biswas and Sarkar; 2018
5	February 12 <sup>th</sup>	<b>Agriculture and Soil Microbiology</b> <ul style="list-style-type: none"> <li>- Soil microbial biodiversity and abundance;</li> <li>- Soil and plant microbiomes;</li> <li>- Pathogenic and beneficial microbes;</li> <li>- Influence of biotic and abiotic factors on food production;</li> <li>- Biodegradation of different substrates by microbes.</li> </ul>	Rillig et al., 2019 Nannipieri et al., 2020 Aguilar-Paredes et al., 2020
6	February 19 <sup>th</sup>	<b>Reading Week</b>	
7	February 26 <sup>th</sup>	<b>Plant microbiome: Benefits, function, and biotechnological applications</b> <ul style="list-style-type: none"> <li>- Importance of microorganisms for agriculture: beneficial and pathogenic;</li> <li>- Microbial inoculants;</li> <li>- Biotechnological solutions for agriculture.</li> <li>- <u>Review for Midterm</u></li> </ul>	Complant et al., 2019 Gilbert et al., 2014 Hardoim et al., 2008

## Schedule (cont.):

Module/ Week	Date	Lecture Topics	Readings
8	March 5 <sup>th</sup>	MIDTERM	
9	March 12 <sup>th</sup>	<b>Bioremediation of contaminated soils</b> <ul style="list-style-type: none"> <li>- <i>In situ, ex situ</i>;</li> <li>- Natural attenuation, biostimulation, bioaugmentation</li> <li>- Bioprospection of microorganisms</li> </ul> <b>Seminar presentations</b>	Agnello et al., 2020
10	March 19 <sup>th</sup>	<b>Biodegradation of plastics; Antibiotic-resistant bacteria</b> <ul style="list-style-type: none"> <li>- Conventional plastics</li> <li>- Bioplastics;</li> <li>- The biology of plastics biodegradation</li> <li>- Mechanisms of antibiotic-resistance</li> </ul> <b>Seminar presentations</b>	Miau et al., 2019
11	March 26 <sup>th</sup>	<b>Biotechnological applications of microorganisms</b> <ul style="list-style-type: none"> <li>- Synthetic biology</li> <li>- Biomining</li> <li>- Microbes and production of pharmaceuticals</li> <li>- Microbes on food production</li> </ul> <b>Seminar presentations</b>	Sarsaiya et al., 2020 Mussagy et al., 2019 Sánchez-Otero et al., 2019
12	April 2 <sup>nd</sup>	Holiday – Good Friday	
13	April 9 <sup>th</sup>	<b>Seminar presentations</b>  Review for the final exam	

## Course Evaluation

- 15 % Quizzes
- 22 % Midterm exam
- 20 % Seminar
- 10 % Participation
- 33 % Final Exam

The evaluation will be carried out in accordance with the Graduate Grading and Evaluation Practices Policy (and how that policy is interpreted and applied in this Dept.)

<http://www.governingcouncil.utoronto.ca/Assets/Governing+Council+Digital+Assets/Policies/PDF/grading.pdf>

## Seminar Evaluation:

- 30% of final mark
- Presentation dates TBD, taking place over 4 classes
- Select a peer-reviewed scientific paper about environmental microbiology
- Submit your presentation for suggestions
- Present the paper in a 20-30 minute seminar presentation, demonstrating your knowledge of the methods used to analyze the data and the significance of the results and conclusions.

## Seminar –rubric

- Described the objective of the paper (10%)
- Put the study into context (10%)
- Informed the class of the methods used to analyze the data (25%)
- Explained the significance of the results (25%)
- Slide readability / good use of audio-visual, etc. (10%)
- Relevance of material to topic (10%)
- Ability to answer class questions (10%)

## Supplementary Readings

- Manual of environmental Microbiology. Cindy H. Nakatsu, Robert V. Miller, Suresh D. Pillai. 4<sup>th</sup> edition. 2016.
- Environmental Microbiology. Ian L. Pepper, Charles P. Gerba, Terry J. Gentry, 2014.
- Microbial Ecology. Ron Atlas and Richard Bartha, 4th edition.
- Brock: Biology of Microorganisms. Michael Madigan et al.; 12th edition.

## Verification of Illness

Students who are requesting special academic consideration based on illness or injury must submit a [Verification of Student Illness or Injury](#) form. *Students must submit the form to the instructor via email and a carbon copy to [Gisela Bento](#) (for record-keeping).*

For COVID-19 related symptoms, the University is temporarily suspending the need for a doctor's note or medical certificate for absences and students must declare this through the Absence Declaration tool on [ACORN](#).

*Visit the UTSC [COVID-19 Absence Declaration in ACORN](#) website for more information.*

## Emergency Planning

Students are advised to consult the university's preparedness site (<http://www.preparedness.utoronto.ca>) for information and regular updates regarding procedures relating to emergency planning.

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## Accessibility needs

The University of Toronto is committed to accessibility. If you require accommodations for a disability or have any accessibility concern about the course, the classroom or course materials, please contact the UTSC Accessibility Services as soon as possible: <http://www.utsc.utoronto.ca/~ability/>

We also suggest you also refer to the following University of Toronto Scarborough Library link: <http://utsc.library.utoronto.ca/services-persons-disabilities>

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## Plagiarism

University of Toronto Code of Behaviour on Academic Matters states that "it shall be an offence for a student knowingly: to represent as one's own any idea or expression of an idea or work of another in any academic examination or term test or in connection with any other form of academic work, i.e., to commit plagiarism.

For accepted methods of standard documentation formats, including electronic citation of internet sources please see the UofT writing website at <http://advice.writing.utoronto.ca/using-sources/documentation>.

*The full Code of Behaviour regulations could be found from consulting* <http://www.sgs.utoronto.ca/facultyandstaff/Pages/Academic-Integrity.aspx>

The University of Toronto has a site license that enables all faculty and students to use Turnitin.com (<http://www.turnitin.com/>), a plagiarism prevention system. For more information on this service please consult <http://teaching.utoronto.ca/ed-tech/teaching-technology/turnitin/>

"Normally, students will be required to submit their course essays to Turnitin.com for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the Turnitin.com reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site".

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## WRITING AND ENGLISH LANGUAGE

As well as the faculty writing support, please see [English Language and writing support at University of Toronto](#) or the [Centre for Teaching and Learning](#) at UTSC.

The following is also useful:

Sylvan Barnett, *A Short Guide to Writing About Art*. 5-7th edition (New York: Harper-Collins, 1997)  
William Strunk Jr., E.B. White. *The Elements of Style* (New York: MacMillan Publishing)

If you opt for Turnitin, this must be included in the document. If not interested, please remove this section.

## Services and Support

The following are some important links to help you with academic and/or technical service and supports:

- General student services and resources at [Student LifeLinks to an external site.](#)
- Full library service through [University of Toronto LibrariesLinks to an external site.](#)
- Resources on conducting online research through [University Libraries ResearchLinks to an external site.](#)
- Resources on academic support from the [Academic Success CentreLinks to an external site.](#)
- [Take-Home and Online Exams](#)
- Learner support at the [Writing Centre Links to an external site.](#)
- Information about [Accessibility ServicesLinks to an external site.](#)
- [Links to an external site.Student Online Course Planning and Resources](#)
- Quercus Information in the [Canvas Student Guide](#)